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(54) Coding of analog image signals

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Codage de signaux d'images analogiques

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- **IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS BOSTONICC/89, vol.3, 14 June 1989, BOSTON pages 1355 - 1359 H. SUN ET AL. 'ADAPTIVE INTERLEAVED VECTOR QUANTIZATION FOR IMAGE TRANSMISSION'**

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Description

[0001] This invention relates to coding of analog image signals. More particularly, but not exclusively, the invention relates to a circuit for quantizing image data used for representing analog image data in the form of a digital quantization code having a predetermined number of bits.

[0002] In general, a previously proposed method for effecting analog-to-digital (A/D) conversion of analog image data has heretofore been carried out in the following manner. That is, a range of values corresponding to the differences between the maximum values and the minimum values both selectable by respective pixels of an original image is divided according to the number of bits capable of being taken out as an output. Each of divided level ranges corresponding to the taken-out number of bits is represented in the form of a code using the corresponding number of bits. It is next decided to which level range the level of each pixel belongs. Further, a code indicative of the divided level range to which the level of each pixel belongs is taken out as a digital output signal. In this case, as a decode level (decode representative level) of the code which represents each divided level range at the time that a digital-to-analog (D/A) converting process is effected, a central value of each level range is used.

[0003] This method is equivalent to a method of minimizing quantization distortion developed in each pixel unit. When the level division is uniformly carried out, it is subjected to linear quantization. On the other hand, when the level division is non-uniformly made depending on the probability of development of a pixel level, it is subjected to nonlinear quantization. However, the norm of minimizing the quantization distortion developed in each pixel unit is applied even to either case as it is.

[0004] Since the above-described A/D converting method can minimize a quantization error developed for each pixel and provide a satisfactory signal-to-noise (S/N) ratio, the analog level of the original pixel can be replaced with a decode representative level nearest to its analog level.

[0005] However, the A/D converting method has a problem in that, although it is quantitatively satisfactory, visually remarkable deterioration is often developed in the restored or reproduced image. This occurs because a human being sees or takes an image as a time variation (motion) in image or a spatial variation (details such as resolution, an outline or contour of an image, etc.) in image without taking the image as one pixel unit.

[0006] When such a variation that the level of an image signal abruptly rises and reaches a flat level occurs as indicated by a solid line a in FIG. 6, for example, a decode signal at the time that the previously proposed A/D conversion for minimizing the quantization distortion for each pixel is effected is represented as indicated by a solid line b (corresponding to a line formed by connecting points indicated by black circles or dots to one another). Even in the case of a range FW indicative of the flat level, the signal is brought into a "jagged or notched" state and is not faithful to a visual variation.

[0007] Such notches give rise to deterioration in image when the reproduced image is seen with human eyes. When the notches are developed in a time direction, they are brought to so-called jerkiness. A so-called edge busyness appears at an edge portion extending in a spatial direction, whereas so-called mosquito noise is produced at a flat portion.

[0008] Thus, the previously proposed A/D converting apparatus has been designed uniformly based on the standard for minimizing the quantization distortion for each pixel and has been out of accord with the human visual characteristic. The more the number of bits increases, the more visual deterioration in image is made nonprominent. However, the previously proposed A/D converting apparatus has a problem in that since the quantized number of bits corresponding to an output signal is fixed, an increase in the quantized number of bits runs to waste and the efficiency of transmission is reduced in the case of such an image that the visual deterioration is not developed.

[0009] Even in the case of images which are in accord with the human visual characteristic, they are different in desired or favorite image quality from each other according to differences among individuals. Since the previous A/D converting method can simply obtain the uniform image created under the standard for minimizing the quantization distortion for each pixel, as each reproduced or restored image, only a method of effecting adjustments such as contrast, tints, sharpness, etc. on a reproduced analog image signal was used to set each image to the desired quality of image.

[0010] European Published Patent Application EP-A-0,531,923 discloses an image-processing system that quantizes image data in a different way depending upon whether the pixel value is above or below a detected background signal level.

[0011] European Published Patent Application EP-A-0,409,602 discloses a video data compression system in which range values are detected and used to control quantization so as to suppress ringing about edge transitions.

[0012] European Published Patent Application EP-A-0,479,510 discloses an image signal coding system in which quantization is controlled on a block-by-block basis in dependence upon the detected activity in signal values within a block of signal values.

[0013] Various aspects of the invention are set forth in the accompanying claims.

[0014] According to at least a preferred embodiment of the invention there is provided an apparatus for effecting A/D conversion of an image signal, which, when reference numerals employed in an embodiment to be described later are associated with the following components, comprises:

an A/D converter for converting the image signal into a first quantization code having an increased number of bits;

class sorting means for effecting a sorting process on a pixel to be marked, according a pattern formed by a plurality of pixels provided near the periphery of the pixel and including the pixel to be marked; and requantizing means for adaptively requantizing a quantization code corresponding to the above pixel produced from the A/D converter according to the result of sorting by the class sorting means and a quality-of-image or image-quality switching signal and converting such a quantization code into a second quantization code having the number of bits not greater than that of the first quantization code.

[0015] Such a preferred apparatus is capable of providing various quality levels of reproduced images and various quantized number of bits.

[0016] According to the preferred apparatus having the above construction, the class sorting means classifies the pixel to be marked into either one of a flat portion, an edge portion, an extreme-value portion, etc. according to the pattern formed by the plurality of pixels near the periphery of the pixel. According to the desired or favorite quality of an image designated based on the image-quality switching signal, the requantizing means effects an adaptive requantizing process for taking great account of a pattern portion necessary as the above quality of image, for example, on each pixel datum output from the A/D converter.

[0017] When, for example, the term pixel fidelity (identical to that employed upon the previously proposed A/D conversion) is selected based on the image-quality switching signal, a pixel code output from the A/D converter is requantized in the form of a fewer second number of bits. When the number of bits in the A/D converter is 10 bits, for example, a code represented in the eight leftmost bits is selected and output by the requantization. The number of bits produced by the requantization can be easily changed based on a switching signal.

[0018] When the term great importance to the visual characteristic is selected based on the image-quality switching signal, an adaptive requantizing process is effected on, for example, a flat portion so as to produce a flat output. The number of bits at this time may be fixed to the number of bits selected based on a number-of-bits switching signal. However, the number of bits may be changed for each pixel.

[0019] According to the preferred A/D converting apparatus, as has been described above, a quantized output code capable of obtaining an image of a quality according to user's preference can be obtained.

[0020] Further, the number of bits to be output can be set according to the user's preference. Since the number of bits can be changed depending on the contents of an image, image data can be output on a low bit-rate basis.

[0021] The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which:

FIG. 1 is a block diagram illustrating one embodiment of an A/D converting apparatus according to the present invention;

FIG. 2 is a view for describing an operation of a partial circuit employed in the one embodiment of the present invention;

FIG. 3 is a view for explaining another operation of the partial circuit employed in the one embodiment of the present invention;

FIG. 4 is a block diagram illustrating one example of the partial circuit employed in the one embodiment of the present invention;

FIG. 5 is a view for describing a further operation of the partial circuit employed in the one embodiment of the present invention; and

FIG. 6 is a view for describing one example of quantized outputs of a previously proposed A/D converting apparatus and the A/D converting apparatus shown in FIG. 1.

[0022] One embodiment of an apparatus for effecting A/D conversion on an image signal, according to this invention will hereinafter be described with reference to the accompanying drawings.

[0023] FIG. 1 is a block diagram showing one embodiment of an A/D converting apparatus according to this invention. An analog image signal Sv input through an input terminal 1 is supplied to an A/D converter 2, where each of pixel samples thereof sampled at a predetermined sampling frequency is converted into a quantization code having the number of bits greater than the number of bits required as an output. In the present embodiment, each of the pixel samples of the input analog image signal Sv is converted into digital pixel data represented in the form of a 10-bit quantization code. The A/D converter 2 is of a conventional A/D converter based on the norm of minimizing quantization distortion.

[0024] The pixel data output from the A/D converter 2 is supplied via a delay circuit 3 used for simultaneous action to a requantizing circuit 4 where each of the pixel sample data is requantized in the form of an adaptive code having the number of bits less than or equal to 10 bits in a manner to be described later.

[0025] The pixel data output from the A/D converter 2 is supplied to a class sorting circuit 5. The class sorting circuit 5 comprises a blocking circuit 51, a patterning circuit 52 and a sort deciding circuit 53. The blocking circuit 51 forms a block based on nine pixels shown in FIG. 2, for example, in which a marked pixel processed by the requantizing circuit 4 is set as the center.

[0026] The nine pixels are the very ones to be laid out or arranged on the screen and comprise three pixels which are arranged along a line L(n-l) provided one line

ahead of a line L (n) including the pixel to be marked and which are situated in positions spatially near the pixel, the pixel arranged along the line L(n) and two pixels situated before and after the pixel, and three pixels which are arranged along a line L(n+l) provided one line after as seen from the line (n) including the pixel and which are situated in positions spatially near the pixel.

[0027] Next, the patterning circuit 52 converts the block comprised of the nine pixels into data convenient to decide to what kind of pixel pattern the block corresponds. In the present embodiment, as shown in FIG. 3, the minimum value MIN of values of the pixels in the block is subtracted from the maximum value MAX of the values to determine a dynamic range DR. Further, the dynamic range DR is uniformly divided into two corresponding to level ranges W1 and W2, and one-bit codes "0" and "1" are respectively set to the level ranges W1 and W2. Thereafter, each pixel is represented in the form of the one-bit code depending on determining to which level range of the W1 and W2 each of the nine pixels in the block belongs. That is, each pixel data is requantized in the form of one bit data.

[0028] Thus, a set of the nine pixels, each of which is represented in the form of one bit, can be regarded or taken as a predetermined pattern comprised of "0" and "1" in a two-dimensional space. Patterning information about the block is supplied to the sort deciding circuit 53. The sort deciding circuit 53 decides, based on the information supplied from the patterning circuit 52, to which pixel pattern the corresponding pixel to be marked belongs to thereby effect a class sorting process. As a result, its class sort is decided. The sort deciding circuit 53 classifies or divides the pixel into a class such as a flat portion in which variations in time and space are low, an edge (outline) of a predetermined image, an extreme-value portion much different from other portions, or the like. Thereafter, the sort deciding circuit 53 outputs information indicative of the result of division therefrom. Further, the sort deciding circuit 53 supplies the information to the requantizing circuit 4.

[0029] The delay circuit 3 provides a delay time interval corresponding to a time interval required for the class sorting circuit 5 to electrically process the pixel to be marked. 10-bit data for the pixel to be marked and the information indicative of the result of division are made concurrent and supplied to the requantizing circuit 4.

[0030] The requantizing circuit 4 is supplied with an image-quality switching signal QSW and a number-of-bits switching signal BSW. In the present embodiment, the image-quality switching signal QSW is of a signal determined depending on the switching action of a changeover switch (not shown) having switching positions for the fidelity of each pixel (minimal quantization of quantization distortion for each pixel unit, which is similar to the conventional example), serious consideration of a visual characteristic, enhancement, edge enhancement, etc. Further, the number-of-bits switching signal BSW is of a signal for setting the number of bits less than or equal to 10 bits or the number of bits less than or equal to 8 bits in the present embodiment depending on the switching action of a number-of-bits changeover switch (not shown).

[0031] When the switching position for the pixel fidelity is selected based on the image-quality switching signal QSW, the requantizing circuit 4 requantizes pixel data based on the number of bits designated or specified in accordance with the number-of-bits switching signal BSW. When 8 bits are specified in accordance with the number-of-bits switching signal BSW, for example, the requantizing circuit 4 outputs the eight leftmost bits of the 10-bit data supplied thereto from the delay circuit 3.

[0032] On the other hand, when the switching position for the serious consideration of the visual characteristic is selected based on the image-quality switching signal QSW, the requantizing circuit 4 requantizes pixel data into an adaptive code coincident with the visual characteristic as will be described below. That is, when an pixel sorted as being the flat portion by the class sorting circuit 5 is selected, for example, the pixel is quantized to an adaptive code in which a difference in time between the pixel and the previous pixel has been taken into consideration. Even in this case, the number of bits corresponding to an output code is decided based on the number-of-bits switching signal BSW.

[0033] FIG. 4 is a block diagram of a requantizing circuit for quantizing a pixel sorted as being a flat portion by the class sorting circuit 5 when the switching position for the serious consideration of the visual characteristic is selected.

[0034] Pixel data input from an input terminal 11 is supplied to a code selecting circuit 12 from which the number of bits selected in response to the number-of-bits switching signal BSW, e.g., a 8-bit output code is taken out. However, an operation for deciding which code should be outputted is controlled based on a control signal DT to be described later.

[0035] That is, the pixel data input from the input terminal 11 is suppled to a subtraction circuit 15 through a one-pixel sample type delay circuit 14 and directly supplied to the subtraction circuit 15. As a result, a difference Δr in time between the pixel to be marked and the previous pixel is obtained.

[0036] Further, the 8-bit output code produced from the code selecting circuit 12 is suppled via a one-pixel sample type delay circuit 17 to a local decoder 18 where it is converted into a 10-bit decode level. Next, each of subtraction circuits B1 through B256 subtracts the 10-bit decode level produced from the local decoder 18 from each of decode representative levels which are supplied from a decode representative level generating circuit 19 and in which values corresponding to 256 steps selectable by the 8-bit code are represented in the form of 10 bits to thereby obtain each of expected differences D1 through D256 between a decode level of a pixel prior to the pixel to be marked and individual decode representative levels corresponding to 256.

[0037] Outputs corresponding to the differences Δ1 through Δ256, which are produced from the subtraction circuits B1 through B256, are supplied to their corresponding subtraction circuits A1 through A256 where differences between the output Δr produced from the subtraction circuit 15 and the individual outputs Δ1 through Δ256 are calculated. Outputs C1 through C256 corresponding to the differences, which are produced from the subtraction circuits A1 through A256, are supplied to a minimum value detecting circuit 16 where the minimum one of the outputs C1 through C256 is detected. Thereafter, the detected output is supplied to the code selecting circuit 12 as the control signal DT. The minimum differential output C means that the amount of change in the expected value is nearest to the amount of change Δr in the true value. A code in which a decode representative level related to the minimum one of the differential outputs C1 through C256 is represented in the form of 8 bits, is output from the code selecting circuit 12.

[0038] According to the above quantization with respect to the serious consideration of the visual characteristic, an image signal indicated by a solid line a in FIG. 6 is adaptively coded (quantized) as indicated by a solid line c (line formed by connecting points corresponding to Δ in FIG. 6 to each other) in FIG. 6 upon decoding the image signal so that the flat portion is formed like the visual characteristic. At this time, the number of bits corresponds to the number of bits designated based on the number-of-bits switching signal.

[0039] The above process shows the case where the output number of bits quantized by the requantizing circuit 4 is 8 bits. Even when the number of bits below the 8 bits is specified, it is needless to say that the above process is effected. Therefore, the number-of-bits switching signal BSW is also supplied to each of the decode representative level generating circuit 19 and the minimum value detecting circuit 16. The decode representative level generating circuit 19 outputs decode representative levels (where the number of bits is 10) of steps corresponding to the number of bits selected based on the number-of-bits switching signal BSW to their corresponding subtraction circuits B1 through B (the number of steps corresponding to the number of bits). Further, the minimum value detecting circuit 16 detects only outputs supplied from the subtraction circuits A1 through A (the number of steps corresponding to the number of bits).

[0040] When the switching position for the edge enhancement is selected based on the image-quality switching signal QSW, the requantizing circuit 4 adaptively requantizes the pixel subjected to the class sorting as being the edge portion by the class sorting circuit 5 into a quantization code like that provides outline or contour enhancement when the original signal shown in FIG. 5A is decoded as shown in FIG. 5B.

[0041] The pixel data requantized in the above-described manner is converted into serial data by a parallel-to-serial converting circuit 6 and the converted serial data is output to an output terminal 7.

[0042] In the above embodiment, the quantized number of bits of the pixel data obtained at the output terminal 7 is represented as a constant value switchably set based on the number-of-bits switching signal BSW. However, the number of bits may be changed for each pixel depending on the result of division by the class sorting circuit. For example, the edge of the image may be outputted on a high bit basis and the flat portion may be outputted on a low bit basis. In this case, the number of bits to be output may be changed in the following manner. That is, the output of the parallel-to-serial converting circuit 6 is supplied to a bit-rate monitoring circuit where the bit rate of pixel data for each field or each frame, for example, is detected. Further, the output of the bit-rate monitoring circuit is fed back to the requantizing circuit 4 to thereby change the output number of bits about the pixel data requantized by the requantizing circuit 4 in such a manner that the bit rate to be transmitted is held constant in the case of a block unit of a predetermined quantity of data or in the case of either one field unit or one frame unit.

[0043] Having now fully described the invention, it will be apparent to those skilled in the art that many changes and modifications can be made without departing from the scope of the invention as defined in the appended claims.

Claims

1. An apparatus for converting an input analog video signal to a digital code, comprising:

   an A/D converter (2) for converting the input analog video signal into a first quantization code having a first number of bits;

   class sorting means (5) for receiving said first quantization code from said A/D converter and for detecting a characteristic of a plurality of pixels including a pixel to be marked and for determining a class corresponding to said pixel to be marked from a plurality of predetermined classes based upon said characteristic; and

   quantizing means (4) for receiving said first quantization code produced from said A/D converter and the class determined by said class sorting means and for adaptively converting said first quantization code of said pixel to be marked into a second quantization code corresponding to said class determined by said class sorting means and having a second number of bits smaller than or equal to the first number of bits;

   characterised in that

   said characteristic detected by said class sort-

ing means corresponds to a pattern of values based on said first quantization code corresponding to said pixel to be marked and said first quantization code corresponding to each of said plurality of pixels provided near the periphery of said pixel.

2. The apparatus according to claim 1, wherein said quantizing means receives an image-quality switching signal which designates an image quality characteristic of an image and adaptively converts said first quantization code of said pixel to be marked into the second quantization code based on said class determined by said class sorting means and said image-quality switching signal.

3. The apparatus according to claim 1, wherein said plurality of predetermined classes includes at least one of a class corresponding to a flat portion in which luminance variation is relatively low, a class corresponding to an edge portion, and a class corresponding to an extreme-value portion.

4. The apparatus according to claim 1, wherein said quantizing means receives a bit switching signal which designates a number of bits and wherein said quantizing means adaptively converts said first quantization code into said second quantization code having a second number bits smaller than the first number of bits based on said bit switching signal.

5. The apparatus according to claim 2, wherein said quantizing means receives a bit switching signal which designates a number of bits and wherein said quantizing means adaptively converts said first quantization code into said second quantization code having a second number of bits smaller than the first number of bits based on said bit switching signal.

6. Apparatus according to claim 1, wherein said quantizing means comprises:

first difference generating means for making a difference between said pixel to be marked and a pixel prior to said pixel to be marked so as to generate a first differential value;
representative code generating means for generating a plurality of kinds of codes each represented in the form of the second number of bits;
code outputting means supplied with said first quantization code, for converting said first quantization code into said second quantization code having the second number of bits and outputting the converted second quantization code therefrom;
a local decoder for decoding said second quantization code output from said code outputting means to the code having the first number of bits;
second difference generating means supplied with the output of said local decoder and the plurality of kinds of codes output from said representative code generating means and for making differences between said output and said plurality of kinds of codes so as to generate a plurality of second differential values;
third difference generating means for making differences between said first differential value and said plurality of second differential values so as to generate a plurality of third differential values; and
detecting means for detecting the minimum one of said plurality of third differential values,
whereby said code outputting means is controlled based on the result of detection by said detecting means when the plurality of pixels including said pixel to be marked are divided into a class corresponding to a flat portion having a reduced variation in luminance by said class sorting means.

7. A method for converting an input analog video signal to a digital code, comprising the steps of:

converting the input analog video signal into a first quantization code having a first number of bits;
receiving said first quantization code and detecting a characteristic of a plurality of pixels including a pixel to be marked;
determining a class corresponding to said pixel to be marked from a plurality of predetermined classes, based on said characteristic;
receiving said first quantization code and the determined class; and
adaptively converting said first quantization code of said pixel to be marked into a second quantization code corresponding to said determined class and having a second number of bits smaller than or equal to the first number of bits; characterised in that
said characteristic detected corresponds to a pattern of values based on said first quantization code corresponding to said pixel to be marked and said first quantization code corresponding to each of said plurality of pixels provided near the periphery of said pixel to be marked.

8. A method according to claim 7, further comprising the step of receiving an image-quality switching signal which designates an image quality characteristic of an image and wherein the converting step adaptively converts said first quantization code of said pixel to be marked into the second quantization

code based on said determined class and said image-quality switching signal.

9. A method according to claim 7, wherein said plurality of predetermined classes includes at least one of a class corresponding to a flat portion in which luminance variation is relatively low, a class corresponding to an edge portion, and a class corresponding to an extreme-value portion.

10. A method according to claim 7, further comprising the step of receiving a bit switching signal which designates a number of bits and wherein the converting step adaptively converts said first quantization code into said second quantization code having a second number of bits smaller than the first number of bits based on said bit switching signal.

11. A method according to claim 8, further comprising the step of receiving a bit switching signal which designates a number of bits and wherein the converting step adaptively converts said first quantization code into said second quantization code having a second number of bits smaller than the first number of bits based on said bit switching signal.

12. A method according to claim 7, further comprising the steps of:

receiving a bit switching signal to thereby select a second number of bits of said second quantization code based on said bit switching signal, and wherein
said step of adaptively converting comprises the steps of:
making a difference between said pixel to be marked and a pixel prior to said pixel to be marked so as to generate a first differential value;
generating a plurality of kinds of codes each represented in the form of the second number of bits;
receiving said first quantization code, converting said first quantization code into said second quantization code having the second number of bits and outputting the converted second quantization code therefrom;
decoding said second quantization code output from said code outputting means to the code having the first number of bits;
receiving an output produced from said local decoder and the plurality of kinds of codes output from said representative code generating means and making differences between said output and said plurality of kinds of codes so as to generate a plurality of second differential values;
making differences between said first differential value and said plurality of second differential values so as to generate a plurality of third differential values; and
detecting the minimum one of said plurality of third differential values,
whereby said code outputting means is controlled based on the result of detection by said detecting means when the plurality of pixels including said pixel to be marked are divided into a class corresponding to a flat portion having a reduced variation in luminance by said class sorting means.

Patentansprüche

1. Vorrichtung zum Umwandeln eines analogen Eingangs-Videosignals in einen digitalen Kode, die umfaßt:

einen A/D-Wandler (2) zum Umwandeln des analogen Eingangs-Videosignals in einen ersten Quantisierungskode, der eine erste Anzahl von Bits hat,
ein Klassensortiermittel (5) zum Empfangen des ersten Quantisierungskodes von dem A/D-Wandler und zum Erfassen eines Merkmals einer Vielzahl von Pixeln, die ein Pixel enthält, das zu markieren ist, und zum Bestimmen einer Klasse, die dem Pixel entspricht, das zu markieren ist, aus einer Vielzahl vorbestimmter Klassen auf der Grundlage des Merkmals und
ein Quantisierungsmittel (4) zum Empfangen des ersten Quantisierungskodes, der von dem A/D-Wandler erzeugt ist, und der Klasse, die durch das Klassensortiermittel bestimmt ist, und zum adaptiven Umwandeln des ersten Quantisierungskodes des Pixels, das zu markieren ist, in einen zweiten Quantisierungskode, welcher der durch das Klassensortiermittel bestimmten Klasse entspricht und eine zweite Anzahl von Bits hat, die kleiner als die oder gleich der ersten Anzahl von Bits ist,

dadurch **gekennzeichnet**, daß
das Merkmal, welches durch das Klassensortiermittel erfaßt ist, einem Muster von Werten entspricht, das auf dem ersten Quantisierungskode, der dem Pixel entspricht, das zu markieren ist, und dem ersten Quantisierungskode basiert, der jedem der Vielzahl von Pixeln entspricht, die nahe der Peripherie des Pixels vorgesehen sind.

2. Vorrichtung nach Anspruch 1, wobei das Quantisierungsmittel ein Bildqualitätsschaltsignal empfängt, das ein Bildqualitätsmerkmal eines Bildes bezeichnet und adaptiv den ersten Quantisierungskode des

Pixels, das zu markieren ist, in den zweiten Quantisierungskode umwandelt, der auf der durch das Klassensortiermittel bestimmten Klasse und dem Bildqualitätsschaltsignal basiert.

3. Vorrichtung nach Anspruch 1, wobei die Vielzahl von vorbestimmten Klassen zumindest eine von einer Klasse, die einem kontrastlosen Teil entspricht, in dem die Leuchtdichtenvariation relativ niedrig ist, einer Klasse, die einem Randteil entspricht, und einer Klasse, die einem Extremwertteil entspricht, enthält.

4. Vorrichtung nach Anspruch 1, wobei das Quantisierungsmittel ein Bitschaltsignal empfängt, das eine Anzahl von Bits bezeichnet, und wobei das Quantisierungsmittel auf der Grundlage des Bitschaltsignals adaptiv den ersten Quantisierungskode in den zweiten Quantisierungskode umwandelt, der eine zweite Anzahl von Bits hat, die kleiner als die erste Anzahl von Bits ist.

5. Vorrichtung nach Anspruch 2, wobei das Quantisierungsmittel ein Bitschaltsignal empfängt, das eine Anzahl von Bits bezeichnet, und wobei das Quantisierungsmittel auf der Grundlage des Bitschaltsignals adaptiv den ersten Quantisierungskode in den zweiten Quantisierungskode umwandelt, der eine zweite Anzahl von Bits hat, die kleiner als die erste Anzahl von Bits ist.

6. Vorrichtung nach Anspruch 1, wobei das Quantisierungsmittel umfaßt:

ein erstes Differenzerzeugungsmittel zum Bilden einer Differenz zwischen dem Pixel, das zu markieren ist, und einem Pixel vor dem Pixel, das zu markieren ist, um auf diese Weise einen ersten Differenzwert zu erzeugen,
ein Darstellungskodeerzeugungsmittel zum Erzeugen einer Vielzahl von Arten von Kodes, wovon jeder in der Form der zweiten Anzahl von Bits dargestellt ist,
ein Kodeausgabemittel, dem der erste Quantisierungskode zugeführt wird, zum Umwandeln des ersten Quantisierungskodes in den zweiten Quantisierungskode, der die zweite Anzahl von Bits hat, und zum Ausgeben des umgewandelten zweiten Quantisierungskodes aus diesem,
einen lokalen Dekoder zum Dekodieren des zweiten Quantisierungskodes, der von dem Kodeausgabemittel ausgegeben ist, zu dem Kode, der die erste Anzahl von Bits hat,
ein zweites Differenzerzeugungsmittel, dem das Ausgangssignal des lokalen Dekoders und die Vielzahl von Arten von Kodes, die von dem Darstellungskodeerzeugungsmittel ausgegeben sind, zugeführt werden, zum Bilden von Differenzen zwischen dem Ausgangssignal und der Vielzahl von Arten von Kodes, um auf diese Weise eine Vielzahl von zweiten Differenzwerten zu erzeugen,
ein drittes Differenzerzeugungsmittel zum Bilden von Differenzen zwischen dem ersten Differenzwert und der Vielzahl von zweiten Differenzwerten, um auf diese Weise ein Vielzahl von dritten Differenzwerten zu erzeugen, und
ein Erfassungsmittel zum Erfassen des minimalen der Vielzahl von dritten Differenzwerten, wodurch das Kodeausgabemittel auf der Grundlage des Ergebnisses der Erfassung durch das Erfassungsmittel gesteuert wird, wenn die Vielzahl von Pixeln, die das Pixel enthält, das zu markieren ist, durch das Klassensortiermittel in eine Klasse eingeteilt ist, die einem kontrastlosen Teil entspricht, der eine verringerte Variation der Leuchtdichte aufweist.

7. Verfahren zum Umwandeln eines analogen Eingangs-Videosignals in einen digitalen Kode, das Schritte umfaßt zum

Umwandeln des analogen Eingangs-Videosignals in einen ersten Quantisierungskode, der eine erste Anzahl von Bits hat,
Empfangen des ersten Quantisierungskodes und Erfassen eines Merkmals einer Vielzahl von Pixeln, die ein Pixel enthält, das zu markieren ist,
Bestimmen einer Klasse, die dem Pixel entspricht, das zu markieren ist, aus einer Vielzahl vorbestimmter Klassen auf der Grundlage des Merkmals,
Empfangen des ersten Quantisierungskodes und der bestimmten Klasse und
adaptiven Umwandeln des ersten Quantisierungskodes des Pixels, das zu markieren ist, in einen zweiten Quantisierungskode, welcher der bestimmten Klasse entspricht und eine zweite Anzahl von Bits hat, die kleiner als die oder gleich der ersten Anzahl von Bits ist,

dadurch **gekennzeichnet**, daß
das Merkmal, welches erfaßt ist, einem Muster von Werten entspricht, das auf dem ersten Quantisierungskode, der dem Pixel entspricht, das zu markieren ist, und dem ersten Quantisierungskode basiert, der jedem der Vielzahl von Pixeln entspricht, die nahe der Peripherie des Pixels, das zu markieren ist, vorgesehen sind.

8. Verfahren nach Anspruch 7, das ferner einen Schritt umfaßt zum Empfangen eines Bildqualitätsschaltsignals, das ein Bildqualitätsmerkmal eines Bildes bezeichnet, wobei der Umwandlungsschritt auf der

Grundlage der bestimmten Klasse und des Bildqualitätsschaltsignals adaptiv den ersten Quantisierungskode des Pixels, das zu markieren ist, in den zweiten Quantisierungskode umwandelt.

9. Verfahren nach Anspruch 7, wobei die Vielzahl von vorbestimmten Klassen zumindest eine von einer Klasse, die einem kontrastlosen Teil entspricht, in dem die Leuchtdichtenvariation relativ niedrig ist, einer Klasse, die einem Rand-teil entspricht, und einer Klasse, die einem Extremwertteil entspricht, enthält.

10. Verfahren nach Anspruch 7, das ferner einen Schritt umfaßt zum Empfangen eines Bitsschaltsignals, das eine Anzahl von Bits bezeichnet, wobei der Umwandlungsschritt auf der Grundlage des Bitschaltsignals adaptiv den ersten Quantisierungskode in den zweiten Quantisierungskode umwandelt, der eine zweite Anzahl von Bits hat, die kleiner als die erste Anzahl von Bits ist.

11. Verfahren nach Anspruch 8, das ferner einen Schritt umfaßt zum Empfangen eines Bitsschaltsignals, das eine Anzahl von Bits bezeichnet, wobei der Umwandlungsschritt auf der Grundlage des Bitschaltsignals adaptiv den ersten Quantisierungskode in den zweiten Quantisierungskode umwandelt, der eine zweite Anzahl von Bits hat, die kleiner als die erste Anzahl von Bits ist.

12. Verfahren nach Anspruch 7, das ferner Schritte umfaßt zum

Empfangen eines Bitschaltsignals, um dadurch eine zweite Anzahl von Bits des zweiten Quantisierungskodes auf der Grundlage des Bitschaltsignals auszuwählen, wobei
der Schritt zum adaptiven Umwandeln Schritte umfaßt zum
Bilden einer Differenz zwischen dem Pixel, das zu markieren ist, und einem Pixel vor dem Pixel, das zu markieren ist, um auf diese Weise einen ersten Differenzwert zu erzeugen,
Erzeugen einer Vielzahl von Arten von Kodes, wovon jeder in der Form der zweiten Anzahl von Bits dargestellt ist,
Empfangen des ersten Quantisierungskodes, Umwandeln des ersten Quantisierungskodes in den zweiten Quantisierungskode, der die zweite Anzahl von Bits hat, und Ausgeben des umgewandelten zweiten Quantisierungskodes daraus,
Dekodieren des zweiten Quantisierungskodes, der von dem Kodeausgabemittel ausgegeben ist, zu dem Kode, der die erste Anzahl von Bits hat,
Empfangen eines Ausgangssignals, das von dem lokalen Dekoder erzeugt ist, und der Vielzahl von Arten von Kodes, die von dem Darstellungskodeerzeugungsmittel ausgegeben sind, und Bilden von Differenzen zwischen dem Ausgangssignal und der Vielzahl von Arten von Kodes, um auf diese Weise eine Vielzahl von zweiten Differenzwerten zu erzeugen,
Bilden von Differenzen zwischen dem ersten Differenzwert und der Vielzahl von zweiten Differenzwerten, um auf diese Weise eine Vielzahl von dritten Differenzwerten zu erzeugen, und
Erfassen des minimalen der Vielzahl von dritten Differenzwerten,
wodurch das Kodeausgabemittel auf der Grundlage des Ergebnisses der Erfassung durch das Erfassungsmittel gesteuert wird, wenn die Vielzahl von Pixeln, die das Pixel enthält, das zu markieren ist, durch das Klassensortiermittel in eine Klasse eingeteilt ist, die einem kontrastlosen Teil entspricht, der eine verringerte Variation der Leuchtdichte aufweist.

Revendications

1. Appareil pour convertir un signal vidéo analogique d'entrée selon un code numérique, comprenant :

un convertisseur A/N (2) pour convertir le signal vidéo analogique d'entrée selon un premier code de quantification comportant un premier nombre de bits ;
un moyen de tri de classe (5) pour recevoir ledit premier code de quantification en provenance dudit convertisseur A/N et pour détecter une caractéristique d'une pluralité de pixels incluant un pixel à repérer et pour déterminer une classe correspondant audit pixel à repérer à partir d'une pluralité de classes prédéterminées sur la base de ladite caractéristique ; et
un moyen de quantification (4) pour recevoir ledit premier code de quantification produit depuis ledit convertisseur A/N et la classe déterminée par ledit moyen de tri de classe et pour convertir de manière adaptative ledit premier code de quantification dudit pixel à repérer selon un second code de quantification correspondant à ladite classe déterminée par ledit moyen de tri de classe et comportant un second nombre de bits inférieur ou égal au premier nombre de bits,

caractérisé en ce que :

ladite caractéristique détectée par ledit moyen de tri de classe correspond à un motif de valeurs qui est basé sur ledit premier code de quantification correspondant audit pixel à repérer et sur ledit premier code de quantification correspondant

à chacun de ladite pluralité de pixels produits à proximité de la périphérie dudit pixel.

2. Appareil selon la revendication 1, dans lequel ledit moyen de quantification reçoit un signal de commutation de qualité d'image qui désigne une caractéristique de qualité d'image d'une image et convertit de manière adaptative ledit premier code de quantification dudit pixel à repérer selon le second code de quantification sur la base de ladite classe déterminée par ledit moyen de tri de classe et sur la base dudit signal de commutation de qualité d'image.

3. Appareil selon la revendication 1, dans lequel les classes de ladite pluralité de classes prédéterminées incluent au moins une classe prise parmi une classe correspondant à une partie plane dans laquelle une variation de luminance est relativement faible, une classe correspondant à une partie de bord et une classe correspond à une partie de valeur extrême.

4. Appareil selon la revendication 1, dans lequel ledit moyen de quantification reçoit un signal de commutation de bits qui désigne un nombre de bits et dans lequel ledit moyen de quantification convertit de manière adaptative ledit premier code de quantification selon ledit second code de quantification comportant un second nombre de bits inférieur au premier nombre de bits sur la base dudit signal de commutation de bits

5. Appareil selon la revendication 2, dans lequel ledit moyen de quantification reçoit un signal de commutation de bits qui désigne un nombre de bits et dans lequel ledit moyen de quantification convertit de manière adaptative ledit premier code de quantification selon ledit second code de quantification comportant un second nombre de bits inférieur au premier nombre de bits sur la base dudit signal de commutation de bits.

6. Appareil selon la revendication 1, dans lequel ledit moyen de quantification comprend :

un premier moyen de génération de différence pour produire une différence entre ledit pixel à repérer et un pixel avant ledit pixel à repérer de manière à générer une première valeur différentielle ;
un moyen de génération de code représentatif pour générer une pluralité de types de codes dont chacun est représenté sous la forme du second nombre de bits ;
un moyen d'émission en sortie de code qui reçoit ledit premier code de quantification, pour convertir ledit premier code de quantification selon ledit second code de quantification comportant le second nombre de bits et pour émettre en sortie le second code de quantification converti depuis ;
un décodeur local pour décoder ledit second code de quantification émis en sortie depuis ledit moyen d'émission en sortie de code selon le code comportant le premier nombre de bits ;
un second moyen de génération de différence qui reçoit la sortie dudit décodeur local et la pluralité de types de codes émis en sortie depuis ledit moyen de génération de code représentatif et pour produire des différences entre ladite sortie et ladite pluralité de types de codes de manière à générer une pluralité de secondes valeurs différentielles ;
un troisième moyen de génération de différence pour produire des différences entre ladite première valeur différentielle et ladite pluralité de secondes valeurs différentielles de manière à générer une pluralité de troisièmes valeurs différentielles ; et
un moyen de détection pour détecter le minimum de ladite pluralité de troisièmes valeurs différentielles,
et ainsi, ledit moyen d'émission en sortie de code est commandé sur la base du résultat de détection par ledit moyen de détection lorsque les pixels de la pluralité de pixels incluant ledit pixel à repérer sont divisés selon une classe qui correspond à une partie plane présentant une variation de luminance réduite au moyen dudit moyen de tri de classe.

7. Procédé pour convertir un signal vidéo analogique d'entrée selon un code numérique, comprenant les étapes de :

conversion du signal vidéo analogique d'entrée selon un premier code de quantification comportant un premier nombre de bits ;
réception dudit premier code de quantification et détection d'une caractéristique d'une pluralité de pixels incluant un pixel à repérer ;
détermination d'une classe correspondant audit pixel à repérer à partir d'une pluralité de classes prédéterminées, sur la base de ladite caractéristique ;
réception dudit premier code de quantification et de la classe déterminée ; et
conversion de manière adaptative dudit premier code de quantification dudit pixel à repérer selon un second code de quantification correspondant à ladite classe déterminée et comportant un second nombre de bits inférieur ou égal au premier nombre de bits,

caractérisé en ce que :
ladite caractéristique détectée correspond à

un motif de valeurs basé sur ledit premier code de quantification correspondant audit pixel à repérer et sur ledit premier code de quantification correspondant à chacun de ladite pluralité de pixels produits à proximité de la périphérie dudit pixel à repérer.

8. Procédé selon la revendication 7, comprenant en outre l'étape de réception d'un signal de commutation de qualité d'image qui désigne une caractéristique de qualité d'image d'une image et dans lequel l'étape de conversion convertit de manière adaptative ledit premier code de quantification dudit pixel à repérer selon le second code de quantification sur la base de ladite classe déterminée et dudit signal de commutation de qualité d'image.

9. Procédé selon la revendication 7, dans lequel les classes de ladite pluralité de classes prédéterminées incluent au moins une classe prise parmi une classe correspondant à une partie plane dans laquelle une variation de luminance est relativement faible, une classe correspondant à une partie de bord et une classe correspondant à une partie de valeur extrême.

10. Procédé selon la revendication 7, comprenant en outre l'étape de réception d'un signal de commutation de bits qui désigne un nombre de bits et dans lequel l'étape de conversion convertit de manière adaptative ledit premier code de quantification selon ledit second code de quantification comportant un second nombre de bits inférieur au premier nombre de bits sur la base dudit signal de commutation de bits.

11. Procédé selon la revendication 8, comprenant en outre l'étape de réception d'un signal de commutation de bits qui désigne un nombre de bits et dans lequel l'étape de conversion convertit de manière adaptative ledit premier code de quantification selon ledit second code de quantification comportant un second nombre de bits inférieur au premier nombre de bits sur la base dudit signal de commutation de bits.

12. Procédé selon la revendication 7, comprenant en outre les étapes de :

réception d'un signal de commutation de bits pour ainsi sélectionner un second nombre de bits dudit second code de quantification sur la base dudit signal de commutation de bits ; et

dans lequel :

ladite étape de conversion de manière adaptative comprend les étapes de :

constitution d'une différence entre ledit pixel à repérer et un pixel avant ledit pixel à repérer de manière à générer une première valeur différentielle ;

génération d'une pluralité de types de codes dont chacun est représenté sous la forme du second nombre de bits ;

réception dudit premier code de quantification, conversion dudit premier code de quantification selon ledit second code de quantification comportant le second nombre de bits et émission en sortie du second code de quantification converti depuis ;

décodage dudit second code de quantification émis en sortie depuis ledit moyen d'émission en sortie de code selon le code comportant le premier nombre de bits ;

réception d'une sortie produite à partir dudit décodeur local et de la pluralité de types de codes émis en sortie depuis ledit moyen de génération de code représentatif et constitution de différences entre ladite sortie et ladite pluralité de types de codes de manière à générer une pluralité de secondes valeurs différentielles ;

constitution de différences entre ladite première valeur différentielle et ladite pluralité de secondes valeurs différentielles de manière à générer une pluralité de troisièmes valeurs différentielles ; et

détection du minimum de ladite pluralité de troisièmes valeurs différentielles,

et ainsi, ledit moyen d'émission en sortie de code est commandé sur la base du résultat de détection par ledit moyen de détection lorsque les pixels de la pluralité de pixels incluant ledit pixel à repérer sont divisés selon une classe correspondant à une partie plane présentant une variation de luminance réduite au moyen dudit moyen de tri de classe.

F I G. 1

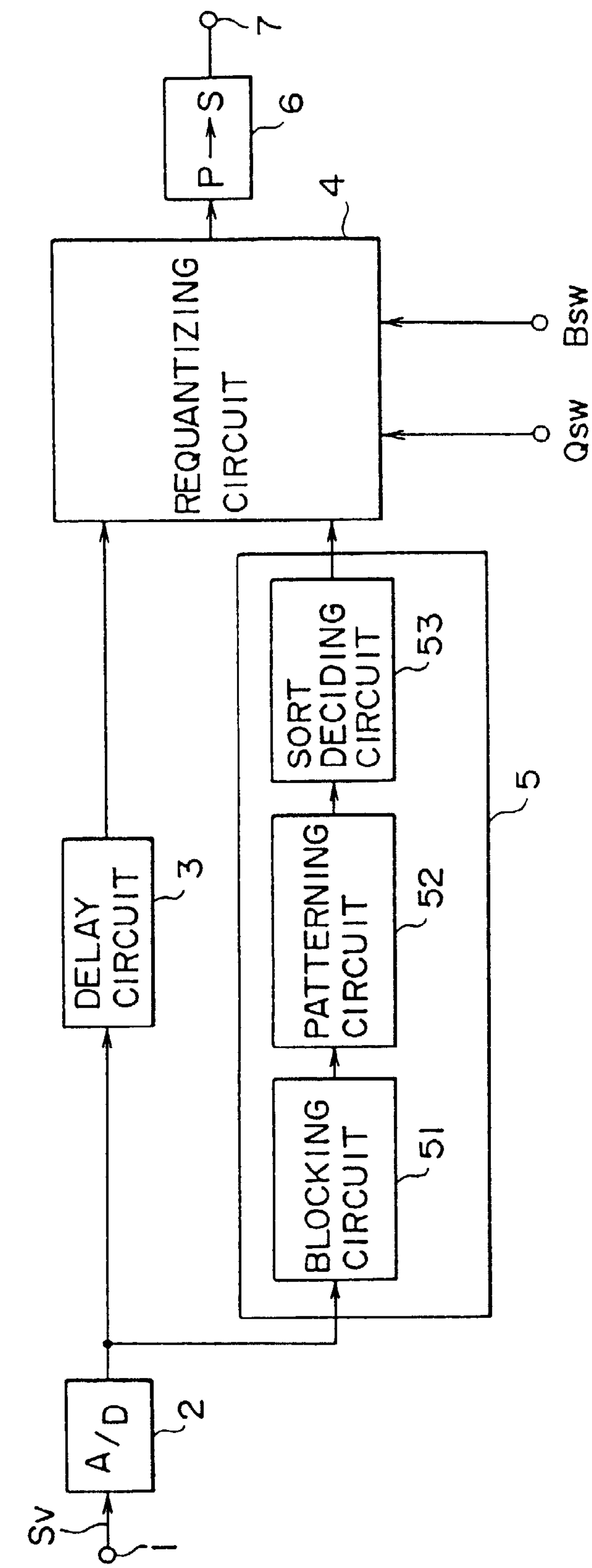
1
Sv
A/D
2
DELAY CIRCUIT
3
BLOCKING CIRCUIT
51
PATTERNING CIRCUIT
52
SORT DECIDING CIRCUIT
53
5
REQUANTIZING CIRCUIT
4
Qsw
Bsw
P → S
6
7

FIG. 2

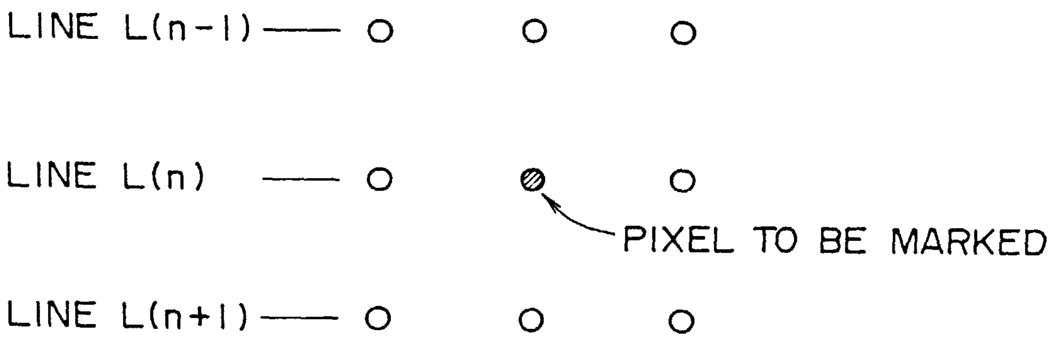

FIG. 3

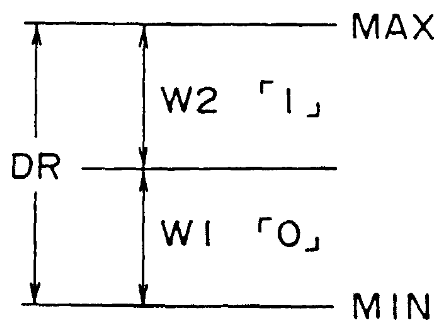

FIG. 4

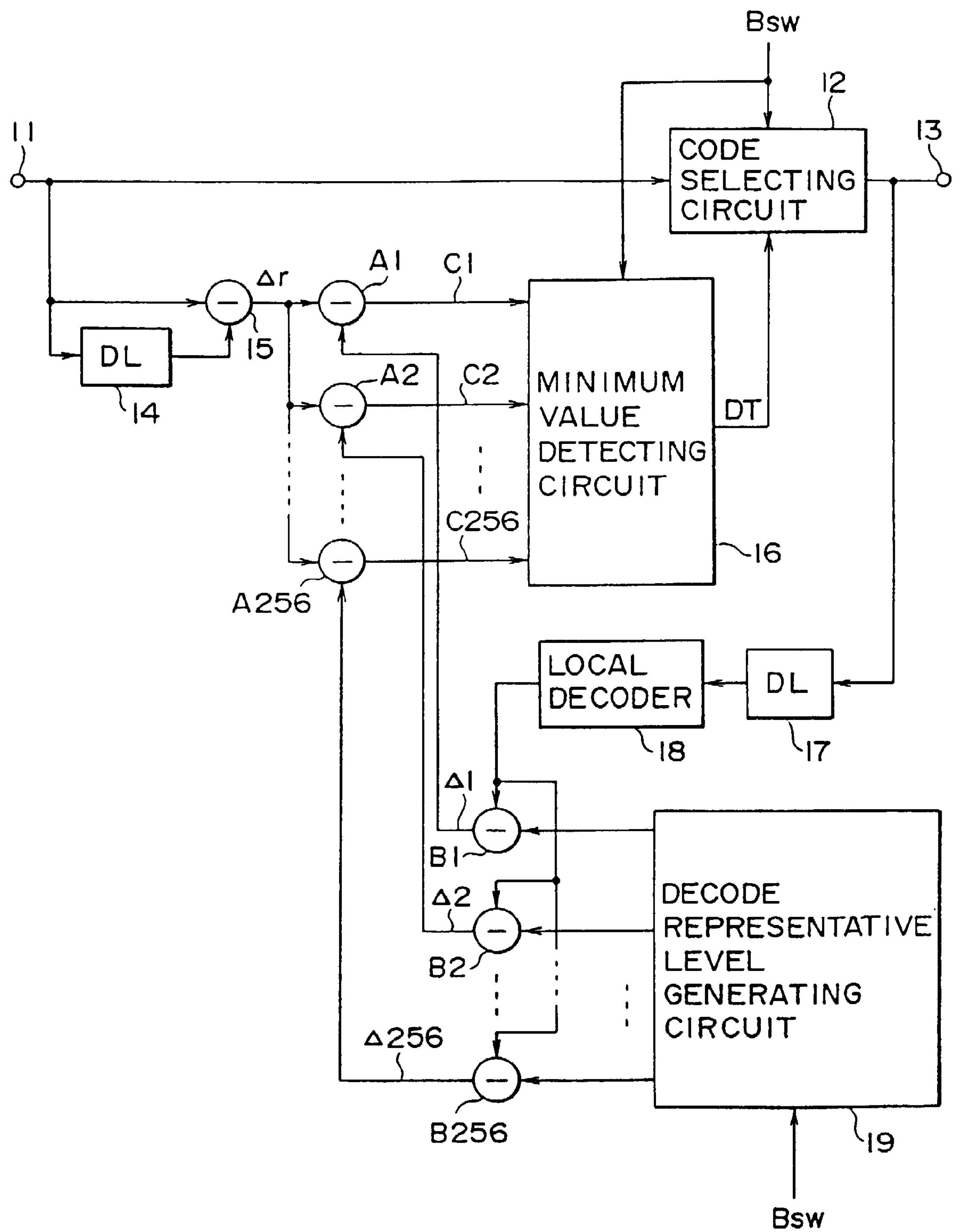
Bsw
12
11
13
CODE SELECTING CIRCUIT
Δr
A1
C1
DL
15
14
A2
C2
MINIMUM VALUE DETECTING CIRCUIT
DT
C256
16
A256
LOCAL DECODER
DL
18
17
Δ1
B1
Δ2
B2
DECODE REPRESENTATIVE LEVEL GENERATING CIRCUIT
Δ256
B256
19
Bsw

FIG. 5A

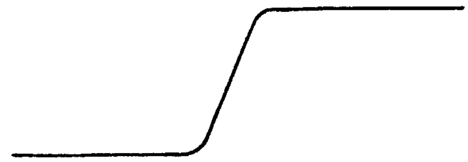

FIG. 5B

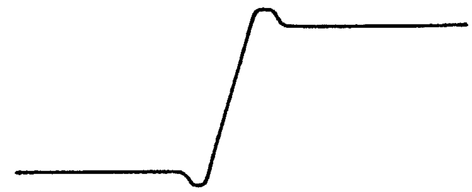

FIG. 6